Chapter 1

Assessment of Undiscovered Oil and Gas Resources of the Anadarko Basin Province of Oklahoma, Kansas, Texas, and Colorado, 2010

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Volume Title Page

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Chapter 1 of 13

Petroleum Systems and Assessment of Undiscovered Oil and Gas in the Anadarko Basin Province, Colorado, Kansas, Oklahoma, and Texas—USGS Province 58

Compiled by Debra K. Higley

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Abstract

The U.S. Geological Survey, using a geoscience-based assessment methodology, estimated mean technically recoverable undiscovered continuous and conventional resources that total 495 million barrels of oil, 27.5 trillion cubic feet of natural gas, and 410 million barrels of natural gas liquids in the Anadarko Basin Province; this assessment includes the Las Animas arch area of southeastern Colorado. The province is at a mature stage of exploration and development for conventional resources. Mean undiscovered continuous resources are estimated at 79 percent of oil, 90 percent of natural gas, and 81 percent of natural gas liquids in the province.

Introduction

The U.S. Geological Survey (USGS) in 2010 completed an assessment of the undiscovered oil and gas potential of the Anadarko Basin Province of western Oklahoma, western Kansas, northern Texas, and southeastern Colorado (fig. 1). The assessment is based on the geologic elements of each defined total petroleum system (TPS), including (1) hydrocarbon source rocks (source-rock richness and thermal maturation, hydrocarbon generation, adsorption, and migration); (2) reservoir rock type (conventional or continuous), distribution, and quality; and (3) types and distribution of reservoir traps and seals, including timing relative to petroleum generation and migration. Using this geologic framework, the USGS defined 2 TPSs, with 12 included assessment units (AU), and quantitatively estimated undiscovered oil, gas, and natural gas liquids resources in each AU (table 1).

The Anadarko Basin Province is in a mature state of exploration and development for conventional resources. Much of the production is reported as being commingled from numerous formations that were deposited over broad age ranges; this commingling influenced grouping of formations into the AUs. The Woodford Composite and Pennsylvanian Composite TPSs represent source rock contributions from numerous Ordovician through Pennsylvanian formations. The Woodford Composite TPS source rocks primarily contribute to Cambrian through Mississippian reservoirs, and those of the Pennsylvanian Composite TPS to Pennsylvanian and Permian reservoirs. Migration and accumulation of hydrocarbons from variable sources can occur along fault systems and updip from the extent of the Woodford Shale and other source rocks. Biogenic gas from the Cretaceous Niobrara Formation is produced from western Kansas and eastern Colorado; however, that resource was evaluated in the Denver Basin Province assessment (USGS Fact Sheet 002–03).

Resource Summary

The USGS assessment of undiscovered conventional and continuous (unconventional) resources within the province resulted in mean estimates of 495 million barrels of oil (MMBO), 27 trillion cubic feet of natural gas (TCFG), and 410 million barrels of natural gas liquids (MMBNGL) within 12 AUs in the 2 TPSs (table 1). Much of the remaining conventional resources are from field growth in this mature province. Continuous resources are focused in the deep part of the Anadarko Basin in Oklahoma and Texas. Boundaries of the Woodford Shale Oil and Woodford Shale Gas AUs and locations of sweet spots within them were based mainly on (1) extent and thickness of the formation, (2) filling of underlying Hunton Formation eroded channels, (3) historical and estimated ultimate production from existing wells, and (4) levels of thermal maturation based on 1D, 2D, and 3D petroleum system models and on vitrinite reflectance maps and data. The Thirteen Finger Limestone–Atoka Shale Gas continuous AU does not have documented production and has limited published information. Boundaries for this AU were based largely on characteristics such as thickness and lateral extent of included formations from well-log examination, and it is within the boundary of wet and dry gas generation based on 1D and 3D petroleum system models. This uncertainty is reflected in a fairly broad range of F5 to F95 resource estimates (table 1); mean undiscovered resources are 6.85 TCFG and 82 MMBNGL.

For Further Information

Supporting geologic studies of total petroleum systems and assessment units and reports on the methodology used in the Anadarko Basin Province assessment are in preparation. Assessment results and geologic reports will be available as completed at the USGS Web site *http://energy.cr.usgs.gov/oilgas/noga/*.

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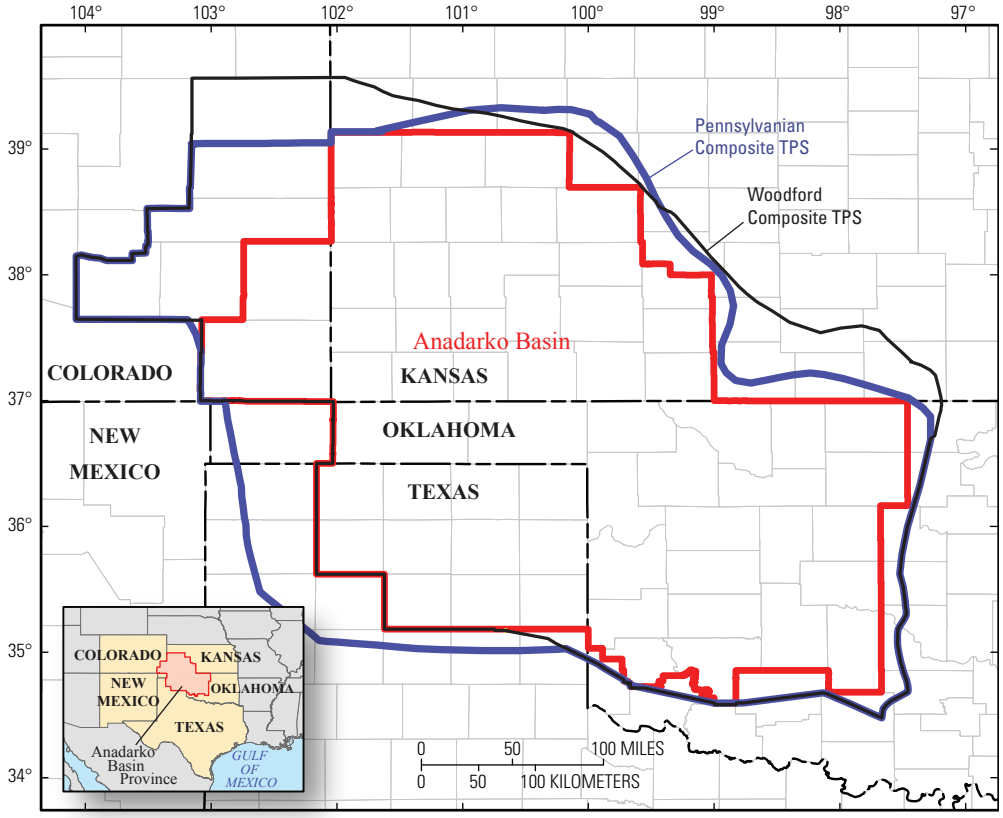

Figure 1. Map showing boundaries of the Anadarko Basin Province (red line), the Woodford Composite total petroleum system (TPS, black line), and the Pennsylvanian Composite TPS (blue line).

Table 1. Anadarko Basin Province assessment results listed by total petroleum system (TPS) and assessment unit (AU). Included are estimated volumes of undiscovered technically recoverable oil, gas, and natural gas liquids (NGL).

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids; gray shading, not applicable. Type refers to mainly oil or gas accumulations in the assessment unit. Fractiles (F95, F50, F5) are fully risked estimates. F95 denotes a 95-percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive only under the assumption of perfect positive correlation]

Total Petroleum Systems (TPS) and Assessment Units (AU)	Field Type	Total Undiscovered Resources											
		Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
		F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Woodford Composite TPS													
Arbuckle-Ellenburger AU	Oil	2	5	12	6	7	24	61	28	0	1	2	1
	Gas					43	164	371	181	0	1	2	1
Simpson Group AU	Oil	2	4	9	5	6	17	39	19	0	0	1	1
	Gas					33	114	252	125	2	9	21	10
Viola Group AU	Oil	2	5	10	5	3	9	20	10	0	1	2	1
	Gas					10	27	58	30	0	0	0	0
Hunton Group AU	Oil	2	8	21	9	8	32	87	38	0	1	3	1
	Gas					71	281	641	310	0	2	4	2
Mississippian AU	Oil	5	16	31	17	15	46	99	50	0	2	4	2
	Gas					125	350	663	367	3	8	17	9
Pennsylvanian Composite TPS													
Morrowan-Atokan AU	Oil	6	14	29	15	21	55	121	61	1	2	5	2
	Gas					101	261	469	271	2	5	10	5
Desmoinesian AU	Oil	2	6	12	6	8	23	52	26	0	1	2	1
	Gas					29	87	167	92	1	3	5	3
Missourian-Permian AU	Oil	10	22	38	23	49	114	223	122	2	4	8	4
	Gas					61	130	231	136	2	4	7	4
Greater Granite Wash Composite AU	Oil	4	14	34	16	22	78	198	90	1	2	7	3
	Gas					192	646	1,496	719	7	24	60	27
Total Conventional Resources		35	94	196	102	804	2,458	5,248	2,675	21	70	160	77
Woodford Composite TPS													
Woodford Shale Oil AU Woodford Shale Gas AU	Oil	175	357	730	393	795	1,750	3,851	1,963	22	51	121	59
	Gas					8,806	15,131	25,998	15,973	94	178	336	192
Pennsylvanian Composite TPS													
Thirteen Finger Limestone-Atoka Shale Gas AU	Oil												
	Gas					3,040	6,229	12,763	6,850	33	73	161	82
Total Continuous Resources		175	357	730	393	12,641	23,110	42,612	24,786	149	302	618	333
Total Resources		210	451	926	495	13,445	25,568	47,860	27,461	170	372	778	410